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OCCUPATIONAL EXPOSURES TO BENOMYL (BENLATE)  
AS REPORTED BY PHYSICIANS IN  
CALIFORNIA FOR 1975 AND 1976

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SUMMARY

During 1975 and 1976, there were in California 38 occupational illnesses or injuries involving exposure to benomyl (Benlate) reported by physicians. Exposure to benomyl was not confirmed as the cause of all these illnesses and injuries. There were indications that in additional incidents larger numbers of employees who did not seek medical attention were also adversely affected with eye and skin injuries of modest severity. This fungicide is a known eye and skin irritant and some persons are more susceptible to injury from it than others. The label warns mixers, loaders and applicators to provide for adequate skin and eye protection. Consideration should also be given to the warning that persons should avoid contact with treated plants for at least four and perhaps as long as seven days. Prevention of all exposures involves avoiding contact with the pesticide and its residues and use of good hygienic practices if contact does occur. Treatment usually results in prompt recovery without adverse after-effects. Persons particularly sensitive to this product should avoid exposure altogether. This chemical is an effective and useful fungicide with a low systemic toxicity. A number of the other widely used fungicides that might be considered as alternate fungicides are also eye and skin irritants. Studies by others have suggested that benomyl may (under circumstances of animal exposure to sizable quantities) have embryotoxic, carcinogenic, mutagenic and/or teratogenic potentials. Although we have no evidence that the use of benomyl as a pesticide has led to such problems in man in California, these suggested potential problems deserve careful evaluation.

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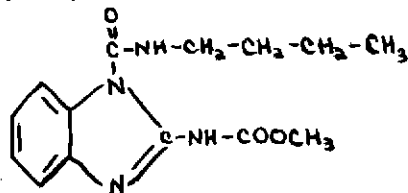
# GENERAL INFORMATION ON BENOMYL

Chemical name: Methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate

Common name: benomyl

Trade names: Benlate, Tersan 1991

Chemical Structure and Formula:



Molecular weight: 290.32

Physical state: The technical material is a white crystalline solid, essentially insoluble in water or oil. The solid decomposes without melting above 300° C.

Formulation: It is sold as a wettable powder containing 50% benomyl under the trade name of Benlate by the DuPont Biochemicals Department.

Use: A systemic fungicide used to control about 30 types of diseases of fruit, nuts, vegetables, field crops, turf and ornamentals. It provides curative and protective action.

## California Pesticide Use Report:

Jan-Dec 1976

| Chemical                   | Applications | Pounds    | Acres     |
|----------------------------|--------------|-----------|-----------|
| Benomyl                    |              |           |           |
| Commodity                  |              |           |           |
| Agencies, Other            |              | 2,807.47  |           |
| Almonds                    | 802          | 26,109.59 | 36,420.45 |
| Almonds                    | 1            | .63       | 30.30     |
| Apple                      | 19           | 169.92    | 213.50    |
| Apricot                    | 278          | 9,106.07  | 11,752.90 |
| Beans                      | 103          | 2,779.07  | 3,792.50  |
| Berries, Other             | 3            | 28.50     | 62.00     |
| Bulbs                      | 9            | 160.25    | 524.00    |
| Cabbage                    | 6            | 20.32     | 80.50     |
| Celery                     | 1,768        | 7,533.68  | 30,636.88 |
| Cherries                   | 46           | 963.71    | 1,179.00  |
| City Agency                |              | 70.86     |           |
| Cucumber                   | 75           | 331.40    | 1,131.10  |
| Deciduous Ornamental Trees | 5            | 13.80     | 4.95      |
| Federal Agency             |              | 9.0       |           |
| Flowers                    | 196          | 1,335.57  | 5,015.93  |
| Grapes                     | 108          | 4,677.14  | 7,115.47  |
| Melons                     | 121          | 2,395.08  | 10,857.35 |
| Mushrooms                  | 2            | 2.50      | .84       |
| Nectarines                 | 179          | 2,339.91  | 2,822.80  |
| Onions                     | 1            | 2.50      | 10.00     |
| Orange                     | 7            | 93.75     | 163.00    |
| Ornamentals                | 88           | 366.42    | 1,076.06  |
| Peach                      | 1,720        | 35,276.24 | 43,008.25 |
| Peach                      | 1            | 10.68     | 34,988.00 |
| Pear                       | 7            | 66.00     | 123.00    |
| Plum                       | 94           | 1,613.94  | 1,631.50  |
| Prune                      | 41           | 1,736.18  | 2,196.00  |

## California Pesticide Use Report:

Jan-Dec 1976

| Chemical                 | Applications | Pounds     | Acres      |
|--------------------------|--------------|------------|------------|
| Benomyl                  |              |            |            |
| Commodity                |              |            |            |
| Recreational Areas       |              | 44.39      |            |
| Residential Pest Control |              | 1,314.88   |            |
| Rice                     | 7            | 40.00      | 90.00      |
| School Districts         |              | 2.50       |            |
| Squash                   | 101          | 569.56     | 2,003.25   |
| State Highways           |              | 7.25       |            |
| Strawberries             | 1,161        | 113,444.18 | 30,130.44  |
| Structural Control       |              | 2.50       |            |
| Sugar beet               | 33           | 1,385.75   | 5,553.00   |
| Tomato                   | 350          | 6,323.24   | 10,024.82  |
| Turf                     | 6            | 156.85     | 67.50      |
| Turf                     | 1            | 3.00       | 1.00       |
| University of California |              | 28.85      |            |
| Watermelons              | 1            | 31.50      | 126.00     |
| TOTAL                    | 7,337        | 123,374.63 | 207,812.99 |

Since benomyl is not a restricted pesticide, large quantities of it are applied by individual growers that are not shown in the applications reported above by licensed pest control operators.

Application: Benomyl is usually applied as a foliar spray by aerial or ground applicator.

Toxicity data: LD<sub>50</sub>, oral, rat=10,000 mg/kg for 50% benomyl

EPA Toxicity Category - Three

## 1975 OCCUPATIONAL EXPOSURES

### Skin Exposures

A nursery worker, who had mixed and loaded chemicals for several months, developed a rash on both hands. He had been working with Benlate, Dexon and Metasystox-R. The employee stated that he had followed the proper safety precautions when handling the chemicals. The injury was diagnosed as a chemical burn and was treated with steroids and antihistamines. The injury was compatible with Benlate overexposure.

An employee working in a greenhouse handled some plant material that was still wet with Benlate spray. She did not wash after handling the plants. She developed dermatitis of the face and arms. Aristocort cream and Prednisone were given as treatment.

Two nursery employees developed skin irritations when Benlate and Truban that was left in the spray lines spilled on their hands. One injury was diagnosed as a nonspecific skin irritation while the other was diagnosed as an allergic reaction to the fungicides. Both workers were treated by physicians with topical agents.

A nurseryman complained of a rash on his face following the use of Benlate and Consan. This was the first time that Benlate had been used at this nursery. The physician diagnosed the condition as dermatitis.

A gardener was spraying flowers with Benlate and he developed a rash on his hands and arms and swelling of his ears. He was given Decadron by injection for treatment of contact dermatitis.

An employee of a crop dusting firm walked downwind from a mixing site and got Benlate on his eyelid. He was not mixing the chemicals. He suffered from marked edema of the eyelids and was given steroids and antihistamines for treatment of his injury.

A worker in a greenhouse was removing old plants when he noticed a rash on his face. The plants had been treated two weeks earlier with Benlate and Captan. The physician's diagnosis was mild dermatosis; probably due to fungicides.

Two workers had been disbudding mums in a greenhouse for several hours when they began to notice a rash on their faces. This was first attributed to Benlate exposure. Subsequent investigations indicated that Benlate and Zectran were not applied until the day after the rashes occurred. Both workers were both given Kenalog cream for treatment of the rash.

### Eye Exposures

While watering in a mushroom growing house, water containing Benlate splashed into an employee's eye. He was not wearing any type of eye protection. A physician diagnosed the injury as conjunctivitis. He was given a prescription for Cortisporin Ophthalmic ointment. The employee returned to work the same day.

A nurseryman was spraying Benlate on some flowers when the nozzle on the sprayer loosened and squirted pesticide into his eyes. The worker was wearing a respirator and coveralls, but no goggles. The injury was diagnosed as chemical conjunctivitis. The physician washed the employee's eyes and issued a prescription for topical agents.

A spray rig operator was spraying a peach orchard with Benlate on a very warm day. The worker would remove his respirator quite often to wipe his forehead. His eyes became irritated late that afternoon. A physician diagnosed the worker's injury as allergic conjunctivitis. The employee was given analgesics and eye ointment for treatment.

A gardener was spraying a rose bed when someone pulled on the hose to straighten it out. The spray shot up in the air and drifted back onto the gardener. Safety equipment had been provided but not used. He was taken to a physician who prescribed a topical preparation for treatment.

A nurseryman had been spraying azaleas with Benlate. When he completed the operation, he scratched his eye with his finger and transferred fungicide to his eye. His eye became red and irritated. He was given steroid-antibiotic drops to facilitate healing. The physician diagnosed the injury as corneal ulcers and conjunctivitis. The employee did not miss any work because of the injury.

A field worker was picking strawberries when she began to notice itching and discomfort in her eyes. She did not go to a doctor for about three weeks. Benlate had been sprayed six days prior to the onset of her injury. She was given eye drops to alleviate the symptoms.

#### Suspected Systemic Exposures

A nursery worker was disbudding mums approximately 200 feet from a spray application of Zectran and Benlate. She said that the spray caused her to become ill with symptoms that included nausea, vomiting, diarrhea and respiratory distress. Benlate has not been known to cause this type of problem. Zectran is a toxic carbamate insecticide and was probably the cause of this illness. Treatment of this illness was not described.

Benlate was applied in a greenhouse the night before a greenhouse worker became ill. She became cold and clammy and could not focus her eyes while working. She was hospitalized for two days for "chemical poisoning." The worker had been sick with the flu several days prior to this illness. Her previous illness was probably a major factor in this case; the role of Benlate might be questioned.

### 1976 OCCUPATIONAL EXPOSURES

#### Skin Exposures

An employee for an aerial applicator was mixing and loading Benlate when he noticed that his eyes were burning and swelling and his arms and neck were also breaking out and itching. It was not stated if the worker was wearing any protective clothing. His injury was diagnosed by a physician as an allergic rash. Treatment was given.

An employee spent all day mixing Benlate and Kocide. He was wearing coveralls, a respirator, goggles, a hard hat, rubber gloves and boots. At the end of the day, the exposed area of the neck was irritated and stained blue. He was examined, given a prescription for a topical ointment and advised to stay away from work for a couple of days.

An employee of a nursery on his first day of training, opened several bags of Benlate while the operator went to the truck to get safety equipment. The trainee got dust on his clothing and skin. By noon a skin rash had started. The injury was diagnosed by a physician as contact dermatitis. He was given Benadryl for treatment of the rash.

A nursery worker was cleaning foliage of some plants that had been treated with Benlate one week earlier. She developed patches of erythematous maculopapular lesions and dry areas. The worker was not working with the common dermatitis-producing plants. She was given injections of ACTH and B<sub>12</sub> and prescriptions for Celestone tablets and a topical ointment.

A greenhouse worker was cutting flowers that had been sprayed earlier in the day with Benlate and Dithane. The worker entered the greenhouse after the plants were dry, but she was not wearing gloves. She developed a scaling, macular pruritic rash on the arms, hands, neck and face. She was given steroids orally and topically for treatment of the rash.

While spraying plants with Benlate a nurseryman got some of the spray on himself. He developed a severe pruritic rash over his thighs, arms, chest and face. The treatment prescribed was not stated. The worker was advised not to return to work for four days.

A nursery worker was spraying roses with Benlate while wearing all of the required safety equipment except gloves. Itching of his hands and arms developed on the day of application. Two days later he noticed a rash. A physician diagnosed the rash as contact dermatitis due to spray and prescribed steroids.

Two employees were working as plant propagators in a nursery. Their job included dipping plants in Benlate and Captan (Orthocide). Both women developed contact dermatitis of their arms. Their hands were protected by gloves. They were given Aristocort tablets for treatment.

A field worker was picking peaches that had been sprayed with Benlate and Kolo Spray four days earlier. He developed a widespread rash with swelling in many areas. A physician gave him an injection of Kenalog and a prescription for Caladryl Spray. The worker was advised not to return to work for four days.

Two field workers were working in apricot orchards that had been sprayed with Benlate four days earlier. Both men developed a rash on their arms and neck. The rashes were diagnosed as contact dermatitis. One worker was given an injection of Kenalog and a prescription for Chlor-Trimeton while the other was given treatment with Benadryl for five days. Both men were advised that in the future they should cover exposed areas of skin and shower after work.

#### Eye Exposures

A gardner was mixing Benlate when the material splashed up into his eye. The worker stated that he usually wore goggles, but was not wearing them at the time of exposure. The injury was diagnosed as blepharoconjunctivitis. The treatment prescribed was not stated.

A gardner was spraying with Benlate when some of the fungicide splashed up into his eyes. It is not known if goggles were worn. A physician diagnosed the injury as chemosis of the eye and prescribed eye drops for treatment.

A nursery worker was planting cuttings that had been dipped in a solution of Benlate, Truban and Agri-strep. Some of the solution on the plants splashed up into the worker's eye. She was provided with gloves and eye protection, but wore only the gloves. Her eye turned red and began to swell. She was taken to a physician who gave her a prescription for eye drops and cream. Two months later her eyes were still watering a little.

A field worker developed conjunctivitis of both eyes while picking strawberries that had been treated with Benlate and Phosdrin five days earlier. She was given a prescription to facilitate healing of the eye and advised not to return to work for two or three days. Phosdrin residue would have decayed to negligible levels in five days and it is not known to cause conjunctivitis whereas Benlate alone has been known to cause this type of problem.

#### Suspected Systemic Illnesses

One employee put together a mixture of Benlate and Dexon in the bottom of a 30-gallon container. Another employee brought over a hose with a high pressure nozzle on it. When the worker turned the water on, the mixture splashed up onto his face. Later he began to experience nausea, burning of his eyes and pressure in his ears. He was hospitalized for 12 hours and released. Benlate was probably responsible for the eye irritation, but exposure to it rarely leads to nausea.

A spray rig operator applied Benlate, Phosdrin and Plictran to strawberries; he said he remembered being able to smell the spray as he applied it. He said he might have also splashed Phosdrin on his face while opening a can. He felt ill the next morning. Since his cholinesterase level was down to 14% of his baseline level, this illness was without doubt due to Phosdrin exposure. He was given medication for organophosphate poisoning.

A spray rig operator became ill while spraying Benlate and Kelthane to a field of strawberries. He stated that he had sprayed chlordane three weeks earlier and had not felt good since. Chlordane exposure often leads to systemic illness and was probably the primary cause of illness in this case.

A nursery worker went to a physician complaining of headaches and eye irritation. He had been spraying Benlate and Pentac to roses in the greenhouse while using all the required safety equipment. Each of these pesticides could have caused the eye irritation, but neither are often involved in producing systemic symptoms.

#### DISCUSSION

As in the several years previous to 1975 and 1976, exposure to Benlate continued to be responsible for skin and eye injuries of modest severity. In addition to the workers who sought medical attention, inquiries and conversations with users of Benlate indicate that it is common knowledge that this product can be quite irritating to the eyes and skin. Sometimes the problems of skin irritation only become apparent after several days of exposure and

sometimes not until a second exposure occurs more than a week after the initial exposure. Without need for medical attention, a significant number of people have mild skin irritation problems that clear up uneventfully after soap and water cleansing and/or avoiding further contact with this fungicide.

During 1975 and 1976 there were 38 occupational illnesses or injuries reported as involving exposure to Benlate by physicians in California. In 1975, there were 18 injuries involving exposure to Benlate. Two of these cases were skin injuries, 6 were eye injuries and 2 were suspected systemic illnesses. The 2 systemic illnesses were probably due to other chemicals to which the workers were exposed or to previous illnesses. In 1976, there were 4 cases of systemic illness that involved some exposure to Benlate; these 4 illnesses were probably caused by other chemicals to which the worker was also exposed. In 1976, there were 12 skin injuries and 4 eye injuries for a total of 20 cases reported as involving exposure to Benlate.

About 61% (23) of the injuries and illnesses reported as involving exposure to Benlate happened to people working in nurseries and greenhouses. The remaining cases were fairly evenly distributed among the following job categories: Gardners, ground applicator, mixer/loader, field workers, and workers exposed to pesticide drift. Six of these cases occurred while the workers were mixing and/or loading Benlate. In many cases, the employee was not wearing enough protective equipment. All employees handling pesticides must be trained and supervised as to the safe and proper use of pesticides. Most of the eye injuries occurred because the employee did not wear eye protection. The rashes usually occurred when there was inadequate protection provided for the skin. In one case, Benlate powder got all over the worker's clothing and he had a rash that covered his entire body because he didn't change his clothes and wash immediately after exposure. If a person is going to mix and load a pesticide that is a known skin irritant, such as Benlate, he should change into clean clothes daily and wash more often than usual, especially those areas that aren't protected.

Twelve cases occurred while workers were in some way applying Benlate (dipping plants or operating a hand-carried spray apparatus or a ground application vehicle). Most of these applicators were not wearing all the desirable protective clothing or it was stated that they did not use it all of the time. While applying pesticides that are known skin and eye irritants, the applicator should wear coveralls, rubber gloves and boots, a hat and goggles or a face shield. The person spraying should always be aware of the wind direction and stay upwind of the spray. When the application is complete, the worker should immediately wash. One person sustained an eye injury because he rubbed his eye before washing up after an application. Spray equipment should be checked periodically to ensure that it is in good working condition.

The remaining workers sustained their injuries as a result of exposure to pesticide drift, exposure to residues on plants or to a spill of some type. Many nursery workers developed rashes as the result of handling plants that had been treated with Benlate. Often the workers were not wearing gloves or long sleeved shirts to protect their hands and arms. One woman handled plants while the fungicide spray was still wet. The spray should at least be dry before workers are allowed to reenter the area where plants have been treated. When working around plants that have been treated with skin-irritant chemicals or plants that are known to cause skin irritations, a person should wear rubber gloves and long sleeves to protect those areas of skin that may come into contact with the foliage. Some persons are extremely sensitive or allergic to Benlate. These persons should be advised not to work with or around this pesticide.



The label states, "Keep Out of Reach of Children. CAUTION! May irritate eyes, nose, throat, and skin. Avoid breathing dust or spray mist. Avoid contact with skin, eyes and clothing. Wash thoroughly after using. Keep away from fire or sparks. In case of contact flush skin or eyes with plenty of water, for eyes, get medical attention."

Following the label instructions carefully should prevent most illnesses and injuries of mixers, loaders and applicators.

There is possibly a need to impose a field worker reentry safety interval of 4 to 7 days in length to allow Benlate residues to dissipate before workers resume activities around treated plants that might result in hand, arm or face contact with residues of Benlate.

Other investigators have observed that under circumstances of excessive exposures of benomyl to tissue cultures and experimental animals, this fungicide has the potential for being embryotoxic, mutagenic, teratogenic, and/or carcinogenic. Although we have no information that persons who use or consume products treated with this pesticide have experienced such effects, the potential for such occurrences should be carefully evaluated.

TABLE 1

OCCUPATIONAL EXPOSURES TO BENLATE IN CALIFORNIA  
FOR 1975 AND 1976 REPORTED BY JOB CATEGORY

| <u>SYSTEMIC</u>         | Subtotal | <u>1975</u> | <u>1976</u> | <u>Total</u> |
|-------------------------|----------|-------------|-------------|--------------|
|                         |          | 2           | 4           | 6            |
| Nursery Worker          |          | 2           | 2           | 4            |
| Spray Rig Operator      |          | 0           | 2           | 2            |
| <u>SKIN</u>             | Subtotal | 10          | 12          | 22           |
| Nursery Worker          |          | 8           | 7           | 15           |
| Field Worker            |          | 0           | 3           | 3            |
| Mixer/Loader            |          | 0           | 2           | 2            |
| Gardner                 |          | 1           | 0           | 1            |
| Worker Exposed to Drift |          | 1           | 0           | 1            |
| <u>EYE</u>              | Subtotal | 6           | 4           | 10           |
| Nursery Worker          |          | 3           | 1           | 4            |
| Gardner                 |          | 1           | 2           | 3            |
| Field Worker            |          | 1           | 1           | 2            |
| Spray Rig Operator      |          | <u>1</u>    | <u>0</u>    | <u>1</u>     |
|                         | Total    | 18          | 20          | 38           |

TABLE 2

OCCUPATIONAL EXPOSURES TO BENLATE IN  
CALIFORNIA FOR 1975 AND 1976 REPORTED BY  
DURATION OF DISABILITY\*

|                     | 1975 | 1976 | Total |
|---------------------|------|------|-------|
| <u>SYSTEMIC</u>     |      |      |       |
| Hospitalization     |      |      |       |
| 12 hrs.             | 0    | 1    | 1     |
| 2 days              | 1    | 0    | 1     |
| Days of Work Missed |      |      |       |
| None                |      |      |       |
| 1-7                 | 0    | 1    | 1     |
| 7-14                | 1    | 0    | 1     |
| Unknown             | 1    | 3    | 4     |
| <u>SKIN</u>         |      |      |       |
| Days of Work Missed |      |      |       |
| None                | 4    | 6    | 10    |
| 1-3 days            | 2    | 1    | 3     |
| 4-7 days            | 0    | 2    | 2     |
| 7-14 days           | 2    | 1    | 3     |
| Unknown             | 2    | 2    | 4     |
| <u>EYE</u>          |      |      |       |
| Days of Work Missed |      |      |       |
| None                | 3    | 2    | 5     |
| 1-3                 | 1    | 1    | 2     |
| 4-7                 | 1    | 0    | 1     |
| Unknown             | 1    | 1    | 2     |

\*Duration of disability is estimated by the physician at the time of the initial examination of the worker.

TABLE 3

OCCUPATIONAL EXPOSURES TO BENLATE IN  
CALIFORNIA FOR 1975 AND 1976 REPORTED BY  
COUNTY OF OCCURRENCE

|               | <u>1975</u> | <u>1976</u> | <u>Total</u> |
|---------------|-------------|-------------|--------------|
| Alameda       | 0           | 2           | 2            |
| Butte         | 0           | 2           | 2            |
| Fresno        | 1           | 1           | 2            |
| Humboldt      | 0           | 1           | 1            |
| Kern          | 0           | 1           | 1            |
| Los Angeles   | 1           | 1           | 2            |
| Merced        | 0           | 1           | 1            |
| Monterey      | 3           | 1           | 4            |
| Sacramento    | 1           | 0           | 1            |
| San Diego     | 3           | 1           | 4            |
| San Joaquin   | 1           | 0           | 1            |
| San Mateo     | 2           | 1           | 3            |
| Santa Barbara | 4           | 5           | 9            |
| Santa Clara   | 1           | 0           | 1            |
| Santa Cruz    | 0           | 1           | 1            |
| Sonoma        | 0           | 1           | 1            |
| Ventura       | <u>1</u>    | <u>1</u>    | <u>2</u>     |
|               | 18          | 20          | 38           |

TABLE 4

OCCUPATIONAL EXPOSURES TO BENLATE BY MONTH OF  
OCCURRENCE IN CALIFORNIA FOR 1975 AND 1976

|           | <u>1975</u> | <u>1976</u> | <u>Total</u> |
|-----------|-------------|-------------|--------------|
| January   | 1           | 4           | 5            |
| February  | 2           | 2           | 4            |
| March     | 4           | 7           | 11           |
| April     | 2           | 0           | 2            |
| May       | 2           | 1           | 3            |
| June      | 1           | 0           | 1            |
| July      | 0           | 1           | 1            |
| August    | 2           | 2           | 4            |
| September | 2           | 1           | 3            |
| October   | 0           | 0           | 0            |
| November  | 0           | 1           | 1            |
| December  | <u>2</u>    | <u>1</u>    | <u>3</u>     |
| Totals    | 18          | 20          | 38           |